COLONOSCOPY AND MR COLONOGRAPHY –A COMPARATIVE STUDY

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CERTIFICATE

This is to certify that **DR. R. Karthikeyan** has been a post graduate student during the period July 2007 to August 2010 at Department of Medical Gastroenterology, Madras Medical College, Government General Hospital, Chennai.

This Dissertation titled **"COLONOSCOPY AND MR COLONOGRAPHY –A COMPARATIVE STUDY" is** a bonafide work done by him during the study period and is being submitted to the Tamilnadu Dr. M.G. R. Medical University in Partial fulfillment of the Branch - IV- D.M. Medical Gastroenterology Examination.

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DECLARATION

I declare that this dissertation entitled **"COLONOSCOPY AND MR COLONOGRAPHY –A COMPARATIVE STUDY"** has been done by me under the guidance and supervision of **Prof. Mohammed Ali, MD, DM**. It is submitted in partial fulfillment of the requirements for the award of DM Gastroenterology degree by The Tamilnadu Dr. M.G.R. Medical University, Chennai. This has not been submitted by me for the award of any degree or diploma from any other University.

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INTRODUCTION

INTRODUCTION

Colorectal cancer (CRC) is the fourth most common cancer in men and the third most common in women, with mortality paralleling incidence[1], in the mid-1970s, approximately 60 cases of colorectal cancer were diagnosed per 100,000 people in the United States, and approximately 51% of those diagnosed survived their disease at least five years. Over the last two decades, incidence rates have fallen by nearly 26% between 1984 and 2004. This decline is likely due to increased colorectal cancer screening, which allows physicians to detect and remove colorectal polyps before they progress to cancer. United States Preventive Services Task Force (USPSTF) recommended screening for CRC should be performed in all persons aged 50 years and older[2]. Yet, incidence is still high: colorectal cancer is the third most commonly diagnosed cancer for both men and women. As of 2004, approximately 48 cases of colorectal cancer were diagnosed per 100,000 people in the United States. About 65% of men and women diagnosed with colorectal cancer now survive their disease at least five years. American Cancer Society recommended the following screening tool for CRC, which includes fecal occult blood test (FOBT) annually, flexible sigmoidoscopy every 5 years as an option, colonoscopy as an option every 10 years, double contrast barium enema recommended every 5 years as an option[3]. Colonoscopy is the gold-standard for evaluation of colonic pathology, but in certain situation where colonoscopy is not possible or incomplete due to procedural pain, colonic stenosis; elongated colon may be found in up to 26% of patients[4]. Thus there has been a need to develop alternative diagnostic procedure to visualize large bowel.

Currently available modalities like Barium enema, which has following drawbacks like 1) Highly subjective 2) Bowel loop superimposed with one another without cross sectional image to see the small lesions 3) Risk of ionizing radiation.

CT Colonography is another alternative but it carries the risk of excessive ionizing radiation and contrast exposure. MR Colonography (MRC) is technically similar to CT Colonography with few advantages.

In recent years major technologic advances in diagnostic MRI have led to improve image quality particularly with the use of Fast sequence and surface coil. Positive contrast like water/saline can be used to distend the colonic lumen; hence without radiation and contrast material we can study the colon using this technique.[5,6]

Sixty patients with suspected colonic pathology were evaluated, thirty patients underwent colonoscopy first then MRC, another thirty patients underwent MRC first which was followed by colonoscopy. Findings in both modalities were compared to know the merits and demerits of each modality.

AIM OF THE STUDY

AIMS AND OBJECTIVE OF THE STUDY

1. To find out the merits and demerits of standard tool colonoscopy and newer modality Magnetic Resonance Colonography (MRC) in assessing the various colonic pathology.
2. To find out the Sensitivity, Specificity. Positive predictive value and Negative predictive value of MRC in comparison with standard tool Colonoscopy
3. To find out the role of MRC in patients with obstructive type of colonic lesion were further scope passage was not possible

REVIEW OF LITERATURE

REVIEW OF LITERATURE

HISTORY OF COLONOSCOPY

Although the first telescopes were developed in Europe in the early 17th century, it was Phillipp Bozzini who first actually tried to observe inside the human body, through a rigid tube without optics. He developed an apparatus called the light conductor (Lichtleiter) in 1805, which he used in his attempt to observe rectum, larynx, urethra, and upper esophagus [7].

In 1853, Désormeaux (1815–81) of France developed the first endoscope of practical value and called this instrument an "endoscope" for the first time in history. Désormeaux utilized his instrument for diagnosis and treatment of urological diseases. Désormeaux's endoscope was essentially a mere hollow rigid tube and did not have a lens in its optical system.

It was Kussmaul who further developed Désormeaux's method and succeeded in making the first gastroscope in 1868.

In 1895 Kelly in the USA produced the first proctoscope of practical value[8]. In 1903 Strauss in Germany followed the Laws' approach, developing a proctosigmoidoscope that distended the sigmoid colon with a rubber hand pump and safety bellows.

Hirschowitz, Peters, and Curtiss, at the University of Michigan, developed a fiberoptic viewing bundle by 1957 and used it to perform the first flexible gastroduodenoscopy. By 1963, three different US teams had produced prototype short instruments and Overholt was able to perform

the first flexible sigmoidoscopy with a relatively crude but four-way angling instrument. A prototype forward-viewing "colonofiberscope" was first made by Olympus for Niwa in 1965.

Progress in electronics led to the American development in 1969 of silicon charge-coupled device (CCDs) containing picture elements (pixels) able to generate electric signals in response to light. Even though Japanese glass fibers were reduced down to 7 μm diameter, with reduced "packing fraction" between fibers and superior resolution, CCD images were able to be made several-fold higher in quality. Early CCDs were too large for small-diameter gastroscopes, so the first "videoendoscope" was a colonoscope produced in the USA by Welch-Allyn Company in 1983 and reported by Sivak and Fleischer[9].

Because CCDs could transmit monochrome brightness of their individual elements but not color (the glass fiber was only for illumination), two methods were devised to display images in color, the "sequential system" and the "white light" or simultaneous system. With the sequential system, light emitted from the light source was converted into strobed colored light by means of rotating red (R), green (G), and blue (B) filters.

Gradually, with miniaturization, CCDs became smaller and the number of pixels increased, resulting in high-quality images.

However, an external diameter of 10–13 mm permits good maneuverability, the instrumentation channel should have an internal diameter of at least 2.8 mm to facilitate the passage of accessories

From the spring steel stiffening wires used by some colonoscopists in the early 1970s there developed a stiffening wire and stiffening tube. The American Cystoscope Makers Inc. (ACMI) internal stiffening wire of 1974 consisted of a core tensioning wire surrounded by a 3.5-mm-

diameter coil. Tensioning the core wire, the outer coil contracted and stiffened. The large diameter required to achieve effective stiffening restricted use to large-channel "therapeutic colonoscopies," such as the ACMI F9A. Thinner wires for standard colonoscopes did not produce the desired stiffness.

Colonoscopy is the current standard for the diagnostic evaluation of the large intestine, using fiberoptic or video versions, every portion of the large bowel can be examined, and therapeutic maneuvers can be performed at any site. A coordinated series of manipulations permits safe intubation through the multiple turns and twists of the colon. An accessory channel allows passage of various instruments through the length of the colonoscope for biopsy or therapy.

INDICATIONS

The two major categories of indications for colonoscopic examination of the colon are diagnostic and therapeutic.

Diagnostic

1. Screening for colorectal neoplasia is the most common indication [10]

2. Symptom Evaluation like Bleeding or Change in bowel habits
3. Preoperative/postoperative evaluation of patients with colon cancer
4. Abnormal barium enema examination
5. Screening or surveillance for neoplasia in high-risk patients[11]
   a. Ulcerative colitis or Crohn's disease of long-standing duration
   b. Family history of polyps or cancer

c. Polyposis syndromes such as familial adenomatous polyposis or HNPCC[12]

d. Persons over 50 years of age

Therapeutic

1. Polypectomy, the most frequent therapeutic intervention during colonoscopy
2. Hemostasis of bleeding lesions[13]
3. Stricture dilation
4. Removal of foreign bodies
5. Decompression (Ogilvie's syndrome or volvulus) [14, 15, 16]

CONTRAINDICATIONS

Absolute

1. Peritonitis with or without bowel perforation
2. Acute diverticulitis
3. Recent myocardial infarction or pulmonary embolus[17]
4. Fulminant colitis

Relative

1. Torrential colonic bleeding
2. Cardiopulmonary instability
3. Poor bowel preparation
4. Uncooperative patient

COMPLICATIONS

Related to diagnostic colonoscopy includes[18, 19, 20] – Bacteremia, Hemorrhage, Perforation, Diastatic serosal tears, Post colonoscopy distention, Vasovagal reflex, Volvulus, Colonic obstruction, Adynamic ileus, Pneumatosis cystoides intestinalis, Incarceration of an instrument in a hernia, Impaction of a scope in a hernia, Aortic aneurysm dissection, Cardiopulmonary problems.

Related to therapeutic colonoscopy includes[21, 22, 23, 24] – Perforation, Hemorrhage, Mucosal burns, Incomplete polypectomy, Explosion, Accidental removal of a ureterosigmoidostomy stoma, Accidental removal of an intussuscepted appendiceal stump, Electrical ileal perforation

PREPARATION

The patient was informed about the indications for the procedure, alternative therapy, possible complications, and the possibility of overlooking lesions.

BOWEL PREPARATION

A colon free of solid stool is the goal, A one-day liquid diet is usually prescribed and we use polyethylene glycol[25] for bowel preparation, one pocket to be mixed in two liters of water to be taken over a period of two hrs usually between 6:00 PM to 8:00 PM on previous day.

EQUIPMENT

1. Video Colonoscope – Pentax EC 3830/EC 3801L, 168 cm in length.
2. Light source and Image processor – EPM - 3300
4. Monitoring equipment (pulse, blood pressure monitor)

5. Ancillary equipment such as biopsy forceps, snares, electrosurgical unit, injector needle

6. Universal precautions with gloves, gowns, masks.

REVIEW OF LITERATURE AND PROCEDURE

COLONOSCOPY

A colonoscopic examination was performed with the patient in the left lateral position using a two-person team. Colon inflated with air deflated with suction, by using angulations control wheels to manipulate the tip up/down or right/left; push the instrument in or withdraw it. After doing rectal examination scope inserted without sedation. Left hand used to adjust the knobs and the right hand to torque the instrument to provide directional changes while insertion or withdrawal of the shaft is performed simultaneously. The colon can be pleated onto the instrument shaft by jiggling the scope with rapid in-and-out motions during intubation, usually with clockwise torque.

VIRTUAL COLONOGRAPHY (VC)

Virtual Colonography (VC) was first introduced by Vining and colleagues[26] in 1994 and has evolved during the last decade as a promising alternative to optical endoscopy. The concept of VC is based on the acquisition of cross-sectional images of the abdomen using either CT or MR imaging. Because of the administration of either liquid or gasiform distending media, the colonic wall can be assessed either on the acquired source data or on virtual endoscopic reformations[27, 28]. VC overcomes some of the disadvantages of optical colonoscopy.

The entire large bowel can be depicted even in the presence of stenotic lesions or elongated bowel segments. The data sets can be assessed in a multiplanar reformation mode on a postprocessing workstation, which enables the display of the colon from any desired angle. This type of multiplanar reformation analysis depicts the colonic wall, the colonic lumen, and all the surrounding abdominal morphology. Hence, analysis is not limited to the bowel itself. All adjacent abdominal structures can be assessed, so colonic lesions can be located more accurately[29]. Since the concept and method of doing MRC is similar to virtual Colonography, MRC has evolved as an alternative method that has several advantages over CTC, like no radiations, better soft tissue contrast and the use of non-nephrotoxic contrast

MR COLONOGRAPHY (MRC)

MR Colonography was first described in 1997 by Luboldt et al[30]. Currently two techniques are being evaluated for MR colonography. Based on the signal within the colonic lumen, they can be differentiated as "Bright lumen"[31,32,33] and "dark lumen" MRC.[34]

In our institution we have 1.5 Tesla MRI, with that 1.5 Tesla MRI and the software available in our institution i did my study. But ideally 3 Tesla MRI[35,36] will give more information like better soft tissue plane delineation and especially for staging growth rectum.

CURRENT ACCEPTED INDICATIONS FOR MRC

Indications are extrapolated from CT Colonography, since both the modality is almost same with the advantage of no radiation with MRC.

(1)Incomplete colonoscopy because an obstructing mass or stricture prevented examination of the proximal colon

(2)Incomplete colonoscopy because of colonic tortuosity, adhesions, severe diverticular disease, or patient intolerance of colonoscopy

(3)Inability to perform colonoscopy because of a strong requirement for anticoagulant therapy or risks of sedation

(4)Patients who have a strong indication for diagnostic colonoscopy but who adamantly refuse to undergo colonoscopy

RELATIVE CONTRAINDICATION FOR MRC

(01) Severe allergy to administered contrast (MRC can be performed even without contrast)

(02) Suspected colonic perforation or peritonitis

(03) Walled off colonic leak/pericolonic abscess

(04) Medically highly unstable patient (eg, unstable angina, uncontrolled sepsis)

(05) Acute lower gastrointestinal bleeding

(06) Pregnancy

(07) Inability to tolerate pneumocolon/water instillation

(08) Highly uncooperative patient

(09) Inability to undergo colonic preparation: congestive heart failure, severe electrolyte imbalances, severe dehydration

(10) Refusal to undergo colonic preparation

(11) Abnormal anorectal anatomy (eg, imperforate anus, tight anal stricture)

(12) Severe colonic disease (toxic colitis, toxic megacolon, severe colonic pseudoobstruction)

(13) Acute colonic infection (acute diverticulitis, severe infectious colitis)

(14) Complete mechanical colonic obstruction

(15) Very recent colonic surgery (<1 week)

Bright lumen MRC

With “bright lumen” MRC[31,32,33] colorectal lesions are visualized as dark filling defects within the bright colonic lumen. This can be achieved by administering a rectal enema containing paramagnetic contrast. On 3D gradient echo data sets only the contrast-containing colonic lumen is bright whereas the surrounding tissues including colonic wall and polyps and growth remain low in signal intensity. A new approach for “bright lumen” MRC is based on the acquisition of True FISP sequences.

Using a rectal water-enema, the contrast mechanism is comparable to that of the approach in conjunction with a paramagnetic contrast enema and the acquisition of T1w GRE sequences**.** Since the True FISP technique neither requires the administration of intravenous nor rectal paramagnetic contrast medium, it appears economically attractive.

The detection of colorectal lesions with “bright lumen” MRC relies on the visualisation of filling defects. Differential considerations for such a filling defect beyond polyps include air bubbles as well as residual faecal material. To permit differentiation datasets are collected in both the prone and supine patient position: air and faecal material move, while polyps remain stationary. While effective in most instances, the technique can introduce errors. Thus, polyps with along stalk may move sufficiently to impress as a moving air bubble or more probably residual stool, while stool adherent to the colonic wall may not move at all and, thus, falsely impress as a polyp.

Dark lumen MRC

In addition to obviating the need for the second, time consuming 3D data acquisition “dark lumen” MRC[34] facilitates the identification of polyps.“Dark lumen” MRC focuses on the colonic wall. It is based on the contrast generated between a brightly enhancing colonic wall and a homogeneously dark colonic lumen.[37]

The technique differs from “bright lumen” MRC in the following manner:

1. Instead of gadolinium containing enema only tap water is rectally applied rendering low signal on heavily T1weighted 3D GRE acquisitions.

2. The colonic filling process is monitored with a fluoroscopic T2w sequence, rather than a T1w sequence.

3. To obtain a bright colonic wall paramagnetic contrast is applied intravenously.3D datasets are collected before the application and after a 75 second delay.

4. As residual air exhibits no signal in the colonic lumen, the examination needs to be performed only in the prone patient position. Furthermore, the “dark lumen” technique copes with the problem of residual stool in a simple manner: if the lesion enhances, it may be a polyp or growth; if it does not enhance, it represents stool. While most mass lesions smaller than 5 mm in size were missed,[38] almost all lesions exceeding 8mm were correctly identified. MRC identified additional lesion in regions of the colon not reached by colonoscopy.

MR colonography was described in 1997 by Luboldt et al.

After in 1997 Royster AP, Fenlon HM, Clarke PD, et al. used new technique of 3D virtual colonoscopy and compared with conventional colonoscopy. they concluded that MR virtual colonoscopy used for complete colonic examination and rectify some of 2D MR colonography drawback.[39]

Vining and colleagues in 1998 repeated virtual colonoscopy and compared with colonoscopy the results were promising and concluded as alternative to optical endoscopy, and virtual colonoscopy useful for complete examination of colon[40] During 1999 Lubolt et al& Ajaj.w et al

discussed about the need of colonic distension .Most colonic loops are collapsed in their physiologic state, the large bowel needs to be distended to allow a reliable assessment of the bowel wall. Otherwise, non distended colonic segments may mimic bowel wall thickening and lead to a misinterpretation of inflammation or even colorectal malignancy. Furthermore, smaller lesions, such as colorectal polyps, may be missed. To assure sufficient distension, the rectal administration of water, water-based fluids, air, or carbon dioxide has been proposed [41,42].

In 2000, A trial by Luboldt W, Bauerfeind P, Wildermuth[42] S, et al. Colonic masses: detection with MR colonography -demonstrated that diagnostic accuracy of MRC was highly dependent on polyp size: although most polyps smaller than five mm were not detected by MRC, the sensitivity for the detection of polyps larger than 10 mm was greater than 90%.[42]

Lauenstein TC, Goehde SC, Ruehm SG, et al. introduced faecal tagging method in 2002.MRcolonography with barium-based faecal tagging- initial experience was favourable to differentiate polyp from faecal material in faecal tagging patients. faecal tagging avoid the need of tedious colonic preparation[29]

During 2003-Ajaj W, Pelster G, Treichel U, et al. compared Dark lumen magnetic resonance colonography with conventional colonoscopy for the detection of colorectal pathology. Dark lumen MRC was as sensitive and specific as colonoscopy in polyp deduction. Using gadolinium contrast polyp seen brightly and extraluminal pathology were well made out[43].

Lauenstein TC, Ajaj W, Kuehle CA, et al.were compared two different Magnetic resonance colonography techniques in 2005. comparison of contrast-enhanced three-dimensional vibe with two-dimensional FISP sequences. preliminary experience shows 3D vibe is superior in

demonstrate polyp than FISP.3D virtual colonoscopy and complete colonic examination is possible with 3D vibe sequence[44]

Late in 2005-Ajaj W, Lauenstein TC, Pelster G, et al. demonstrate the advantages of MR colonography in patients with incomplete conventional colonoscopy.MRC is useful to examine patients with distal colonic stenosis[45]

During 2005-Schreyer AG, Rath HC, Kikinis R, et al. Comparison of magnetic resonance imaging colonography with conventional colonoscopy for the assessment of other intestinal lesion like intestinal inflammation in patients with inflammatory bowel disease. The results were inconclusive.[46]

After in2005-Hartmann D, Bassler B, Schilling D, et al. used MR colonography in patients Incomplete conventional colonoscopy and in the evaluation of the proximal colon.MRC is superior to colonoscopy in detection of proximal colon lesion in case of distal stenosis/obstruction.[47]

2006 -Rottgen R, Herzog H, Bogen P, et al. MR colonoscopy at 3.0 T: comparison with 1.5 T in vivo and a colon model[36]. 3T MRC gives high resolution and useful for 5mm polyp.

2006-Hartmann D, Bassler B, Schilling D, et al. Colorectal polyps: detection with dark-lumen MRcolonography versus conventional colonoscopy. Extraluminal pathology well demonstrated by dark lumen MRC which is not possible by colonoscopy[47]

In 2007-Kinner S, Kuehle CA, Langhorst J, et al. were compared MR colonography versus optical colonoscopy on the basis of patient acceptance, the results concluded that of MRcolonography is equally acceptable to colonoscopy in screening population[48]

2007-Kuehle CA, Langhorst J, Ladd SC, et al. MR colonography without bowel cleansing—a prospective cross-sectional study in which concluded that fecal tagging is highly acceptable by screening population[49]

Numerous factors can limit the accuracy of MRC:

Stool/inadequately prepared colon(overcome with fecal tagging)

Inadequate colonic distention

Colonic spasm

Uncooperative patient

Motion artifacts from respiration

Old MRI machine

Inadequate radiologist training

Flat (nonpolypoid) colonic lesions that are hard to detect by MRC

Pitfalls of MRC

Failure to detect a lesion may be due to technical factors (eg, bowel preparation, bowel distention), the primary reading technique, or reader skill and experience. Misinterpretation of findings can be avoided by careful analysis of the morphology of every potential lesion on multiple views by changing patient position from supine to prone and vice versa.

Polyps have rounded or lobulated contours and homogeneous soft tissue attenuation. Submucosal lesions can mimic the smooth and polypoid appearance of mucosal polyps.

Bulbous colonic folds may mimic colonic polyps on 2D and 3D images, but sequential review of the suspected abnormality in the axial, coronal, and sagittal images should clarify that the abnormality represents a fold rather than a polyp.

An inverted appendiceal stump may mimic a cecal lesion on 2D and 3D images. When a suspected lesion is demonstrated in the expected region of the appendiceal orifice, an attempt should be made to identify a normal appendix.

If the appendix is not identified, it is important to determine whether the patient has had prior inversion-ligation appendectomy. A prominent ileocecal valve can mimic a cecal mass. Therefore, the ileocecal valve should be identified in every study. The normal valve often contains macroscopic fat. The terminal ileum also can be located and followed to the ileocecal valve on axial or coronal images.

Table – 1 showed the comparison of sensitivity of polyp detection and other important factors of various imaging modalities.

TABLE - 1

COLONOSCOPY AND OTHER IMAGING MODALITIES

ADVANTAGES AND DISADVANTAGES

Parameters	**Colonoscopy**	**DCBE**	**CTC**	**MRC**
Intervention possible	Yes	No	No	No
Portion of colon examine	80 -95%	90 – 95%	100%	100%
Mucosal abnormality detection	Yes	No	?	?
Sensitivity of polyp detection size < 1cm	75%	50 – 80%	33 – 70%	61%
Sensitivity of polyp detection size >1cm	90%	75 – 95%	82 – 93%	96%
Sensitivity for polyp &cancer	100%	95%	90 -97%	99%
	Yes	No	Yes with	Yes with

Distinction of fecal residue from polyp			contrast	contrast
Operator dependent	Yes	Yes	No	No
Sedation req.	Yes	No	No	No
Patient preference	Low	Low	High	Undetermined
Risk of perforation	1 in 1000	1 in 25000	Undetermined	Undetermined
Cost	High	Low	High	High

DCBE – Double contrast Barium Enema
CTC – CT Colonography
MRC – MR Colonography

COLORECTAL CANCER

Colorectal adenocarcinoma is a major human health problem. Worldwide this malignancy affects one million individuals each year and causes 500 000 deaths annually[1]. Although colorectal cancer occurs mainly in Western and industrialized countries, since 1950 the incidence of this neoplasm has also increased in traditionally low-incidence regions. In United States, each citizen has a 6% lifetime risk of colorectal cancer, and, strikingly, this tumor is the second leading cause of cancer-related death after lung cancer.

In 2005, 145 000 persons were diagnosed with and 56 000 individuals died of colorectal cancer in the United States. In some individuals with this malignancy, germ-line mutations are the readily identifiable cause. But in most, the development of cancer appears to be a complex interaction between the host genome and environmental factors. Advances in knowledge of colorectal cancer have resulted in improvements in surgical/endoscopic techniques,

epidemiology, screening, and surveillance of high-risk groups. Several new chemotherapeutic agents have been developed as a result of our basic scientific understanding of tumor biology. Yet, despite these advances, surgery still remains the treatment offering the greatest hope for cure. Because colorectal cancer usually arises over a prolonged period and is accessible to screening techniques, secondary prevention remains the best way to decrease death from this malignancy, colorectal cancer is an important global health problem. In 2000, an estimated 944 717 incident cases of colorectal cancer were diagnosed worldwide, with almost equal gender distribution: 498 754 cases in males and 445 963 in females[50]. Globally, about 500 000 individuals die annually from this malignancy[51]. Worldwide, colorectal cancer is the third most commonly diagnosed malignancy after lung and breast cancer[52]. The incidence of this malignancy increases dramatically between 45 and 50 years of age, with 90% of cases occurring after the age of 50 years[53,54]. Consequently, deaths from colorectal cancer begin to increase slowly in the fifth decade of life, rising steeply with advancing age[53,54], In general, the incidence of colorectal cancer continues to increase rapidly in countries with formerly a low risk (particularly Japan but also Asian countries). In high-risk countries, the trends are either gradually increasing or stabilizing (north and west Europe) or declining with time (North America).

Geographical variation

The occurrence of colorectal cancer varies greatly worldwide, with an almost 25-fold difference between specific populations. The highest annual incidence rates occur in Australia and New Zealand, followed by North America and Japan (75.8 to 85.1 per 100 000). Incidence tends to be lowest in middle, south central, and western Africa (5.8 to 8.6 per 100 000). In United States, the

ratio of colon to rectal cancer is about 2:1, and in low-risk areas it is closer to 1:1[51] but in my study the incidence of rectal cancer is very high when compared to growth arising from rest of the colon. Incidence of CRC in India is 2 to 8 per 100,000.

Anatomical trends

Analysis of US colorectal cancer incidence data reveals that about 40% of malignancies occur in the right colon (cecum, ascending colon, hepatic flexure, and transverse colon), 31% in the left colon (splenic flexure, descending colon, and sigmoid colon), and 29% in the rectum.

Etiology

In a minority of cases, the occurrence of colorectal adenocarcinoma is directly attributable to a definable, usually inherited, molecular cause. However, in the vast majority of patients, this tumor results from a complex interaction between environmental factors and genetic predisposition

Risk Factors for Colorectal Cancer

(a) Age > 50 yr

(b) High-fat, low-bulk diet

(c) Personal history of Colorectal adenomas (synchronous or metachronous)

(d) Family history of FAP, HNPCC, Polyposis syndromes: FAP, Gardner's syndrome, Turcot's syndrome, Muir-Torre syndrome, Peutz-Jeghers syndrome, familial juvenile polyposis, First-degree relatives with colorectal cancer

(e) Inflammatory bowel disease – Ulcerative colitis, Crohn’s Disease

Table – 2 showed the various environmental risk factor for CRC

Table - 2

ENVIRONMENTAL RISK FACTORS IN THE CAUSATION OF CRC

Risk factors	**Increased risk (RRa)**
High red meat intake	1.5 – 3.6
Obesity	2.0
Cigarette smoking	1.9
High calorie intake	1.7
High fat intake	1.2
Alcohol intake	1.4 – 1.7
Protective factors	**Decreased risk**
Physical activity	0.7 – 0.8
High calcium intake	0.54 – 0.85
Folate intake	0.25 – 0.66
Selenium intake	0.58
Estrogen/Progesterone	0.63 – 0.82
NSAIDs	0.58 – 0.60
Fiber intake	0.58 – 0.65
Fruits and vegetable intake	0.48

CRC IN INDIA

The incidence rates of both large and small bowel cancer are low in India, and rectal cancer is more common than colon cancer. The incidence rates of colon cancer in eight population registries vary from 3.7 to 0.7/100,000 among men and 3 to 0.4/100,000 among women[55]. As per the latest study conducted in Kasturba Medical College, Manipal University, India[56] on the effect of using combination chemotherapy in colorectal cancer in India: A single institute survey Incidence of cancer in male: female is 6.7:5.5 per 100, 000 population in India.

Due to various reasons, the incidence of colorectal cancer is on increasing trend in India (Mohandas et al., 1999) For rectal cancer the incidence rates range from 5.5 to 1.6/100,000 among men and 2.8 to 0/100,000 among women. One intriguing observation is the occurrence of rectal cancer in young Indians. Rural incidence rates for large bowel cancers in India are approximately half of urban rates. Immigrant studies reveal an increase in incidence as compared to the rates in native counterparts. Reliable time trends for India are available only from the Bombay registry. Significant increase in the incidence of colon cancer has been reported for both men and women over two decades, but the rates of rectal cancer are steady. The low incidence of large bowel cancers in Indians can be attributed to high intake of starch and the presence of natural antioxidants such as curcumin in Indian cooking. High rates of rectal cancers in young Indians could suggest a different etiopathogenesis, which is neither inherited nor traditional diet-related. Incidence rates in India are quite low about 2 to 8 per 100,000.

SCREENING FOR CRC

Only one half of the average-risk population in the United States undergoes any of the currently available screening tests for colorectal cancer, however[57], because of safety concerns, test invasiveness, inconvenience, costs, embarrassment, and lack of education concerning colon cancer screening[58]. Cancer prevention is categorized into primary or secondary, primary prevention refers to the identification of genetic, biologic, and environmental factors that are etiologic or pathogenetic and subsequent alteration of their effects on tumor development. Although several areas of study have been identified that may lead to primary prevention of large bowel cancer, available data do not yet provide a firm basis for the practical application of primary preventive measures. The goal of secondary prevention is to identify existing preneoplastic and early neoplastic lesions and to treat them thoroughly and expeditiously. The assumption is that early detection improves prognosis.

Results from randomized controlled clinical trials (RCT) have shown that with current technology, screening can greatly reduce colorectal cancer mortality and incidence[59,60].

Screening for CRC is broadly divided into

1. Average risk,

2. Increased risk,

3. High risk.

Various recommendations are available for screening including

1. American cancer society

2. US Preventive services task force

3. Multidisciplinary Expert Panel

Screening methods

FOBT(Guaiac test and Immunoperoxidase method), FOS (Fiberoptic sigmoidoscopy), Colonoscopy, Double contrast Barium enema(DCBE).

Other modalities available for evaluation of COLON/CRC Screening but not recommended by various societies like American cancer society etc.

(a) Stool DNA by PCR to detect mutations like K-ras, APC, p53 and BAT-26

mutations.

(b) CEA (Useful in the preop staging and postop follow-up of pts with large bowel cancer)

(c) Capsule Endoscopy

(d) Chromoendoscopy

(e) Computed tomography (CT) colonography, or “virtual” colonoscopy

(f) MR Colonography

RECOMMENDATIONS FROM THE AMERICAN CANCER SOCIETY

For Average risk individuals

Beginning at age 50, men and women should follow one of these five testing schedules:

Yearly fecal occult blood test (FOBT) or fecal immunochemical test (FIT)

Flexible sigmoidoscopy every 5 years

Yearly FOBT or FIT, plus flexible sigmoidoscopy every 5 years

Double-contrast barium enema every 5 years

Colonoscopy every 10 years

All positive tests should be followed up with colonoscopy

For increased risk individuals

People with single, (<1 cm) adenoma	3-6 yr after initial polypectomy	Colonoscopy	If normal, patient can thereafter be screened as per guidelines for an average-risk person
People with a large (≥1 cm) adenoma, multiple adenomas, or adenomas with high-grade dysplasia or villous change	Within 3 yr after initial polypectomy	Colonoscopy	If normal, repeat examination in 3 yr; if normal, the patient can thereafter be screened as per average risk guidelines
Personal history of curative-intent resection of colorectal cancer	Within 1 yr after cancer resection	Colonoscopy	If normal, repeat examination in 3 yr; if normal, repeat examination q 5 yr
Either colorectal cancer or adenomatous polyps in any first-degree relative before age 60 yr, or in ≥2 first-degree relatives at any age (if not a hereditary syndrome)	Age 40 yr, or 10 yr before the age of the youngest case in the immediate family (whichever is sooner)	Colonoscopy	Every 5-10 yr

For High Risk Individuals

Family H/O FAP	Puberty	Surveillance with FOS, & counseling to consider genetic testing	If genetic testing +ve, colectomy is indicated and refer the pt. to center with experience in FAP Rx
Family history of HNPCC	Age 22 yrs	Colonoscopy & genetic testing	If the genetic testing is +ve or not done q 1-2yrs until age 40 yrs.then annually, these pts are better referred to centre with experience in HNPCC Rx
IBD (UC, Crohns)	Cancer risk become significant 8 yrs after Pancolitis, 10-15 yrs after left sided colitis	Colonoscopy with Bx for dysplasia	Every 1-2yrs. Then pts. Referred to center with experience in IBD survilence and Tx
Either colorectal cancer or adenomatous polyps in any first-degree relative before age 60 yr, or in ≥2 first-degree relatives at any age (if not a hereditary syndrome)	Age 40 yr, or 10 yr before the age of the youngest case in the immediate family (whichever is sooner)	Colonoscopy	Every 5-10 yr; colorectal cancer in relatives more distant than first-degree does not increase risk substantially above the average-risk group

STAGING OF CRC

AJCC TNM Staging of Colorectal Cancer

Stage	Criteria
0	Carcinoma in situ: intraepithelial or invasion of lamina propria (Tis N0 M0)
I	Tumor invades submucosa (T1 N0 M0)—Dukes A
	Tumor invades muscularis propria (T2 N0 M0)
II	Tumor invades through the muscularis propria into subserosa or into nonperitonealized pericolic or perirectal tissues (T3 N0 M0)—Dukes B
	Tumor perforates the visceral peritoneum or directly invades other organs or structures and/or perforates visceral peritoneum (T4 N0 M0)
III	Any degree of bowel wall perforation with regional lymph node metastasis
	N1: metastasis in 1-3 regional lymph nodes
	N2: metastasis in ≥4 regional lymph nodes
	Any T N1 M0—Dukes C
	Any T N2 M0
IV	Any invasion of bowel wall with or without lymph node metastasis, but with evidence of distant metastasis
	Any T
	Any N M1

Usually we do CECT Abdomen for staging colorectal malignancy but while subjecting the patient for ***MRC/MRI Abdomen, staging of colorectal malignancy is very accurate especially for staging carcinoma rectum.***

INFLAMMATORY BOWEL DISEASE – ROLE OF COLONOSCOPY AND MRC

Patients, who have chronic IBD, whether classified as ulcerative colitis or Crohn's colitis, are at greater than average risk of developing CRC[61]. A recent meta-analysis of 116 studies found the overall prevalence of CRC in ulcerative colitis to be 3%, with a cumulative risk of CRC of 2% at 10 years, 8% at 20 years, and 18% at 30 years[62]

There also is considerable geographic variation, with higher rates of cancer in the United States and United Kingdom and lower rates in Scandinavia [62].

The mean time from the diagnosis of colitis to the diagnosis of cancer is 17 years, with a mean age at diagnosis of cancer of 51 years for men and 54 for women[63]. One study suggested that colon cancer accounts for one third of deaths in ulcerative colitis[64], whereas another study found that this cancer accounts for only one sixth of deaths[65].

Both Crohn's colitis and Ulcerative colitis tend to have cancer diagnosed after eight years of IBD and frequently have multifocal cancer with an aggressive (signet ring or mucinous) histology.

The precise pathogenesis of CRC in IBD is unclear. The pathogenesis is believed to involve chronic inflammation leading to increased cell proliferation with subsequent development of dysplasia[66,67].

Colonoscopic surveillance to prevent colon cancer in IBD is based on the concept of stepwise progression from chronic inflammation through low-grade dysplasia (LGD) and high-grade dysplasia to cancer.

Risk factors for CRC in patients who have IBD

(1) Duration of disease

(2)Extent of colitis

(3)Primary sclerosing cholangitis

(4)Family history of CRC

(5)Inflammatory pseudopolyps

(6)Degree of histologic inflammation

The coexistence of primary sclerosing cholangitis (PSC) confers an approximately fivefold increase in CRCrisk[68 - 71]. In IBD-related cancers, however, the precursor dysplastic lesion often is flat and may not be readily evident endoscopically. Thus, the primary strategy for preventing CRC in patients who have IBD is surveillance colonoscopy with multiple random biopsies throughout the colon to detect dysplasia, with subsequent proctocolectomy for patients harboring dysplastic lesions in the hopes of preventing progression to cancer or of removing cancer at an earlier, potentially curable, stage.

Despite the lack of conclusive evidence of benefit, surveillance colonoscopy with biopsy currently is recommended by the major gastrointestinal societies worldwide, including the American Gastroenterology Association, the American Society for Gastrointestinal Endoscopy, and the American College of Gastroenterology.

The recommendation is that screening should begin 8–10 years after the onset of symptoms in patients with pancolitis or left-sided colitis. Surveillance should be repeated at 1- to 2-year

intervals. For patients with only proctosigmoiditis the risk of colon cancer is considerably lower than that for patients with left-sided disease or pancolitis and in this population the recommendation for colon cancer screening is the same as for the general population.

For patients who have ulcerative colitis and primary sclerosing cholangitis there is a markedly increased risk of colon cancer compared with patients who have ulcerative colitis alone and yearly colonoscopic examinations are recommended beginning as soon as the diagnosis of primary sclerosing cholangitis is made. The consensus recommendations for surveillance colonoscopy include four-quadrant biopsies taken every 10 cm, beginning at the proximal extent of disease.

Guidelines have been developed for decision-making based on the results of the surveillance biopsies[72]. A patient with low-grade or high-grade dysplasia found in a discrete adenoma-like polyp, but nowhere else, can be safely managed with polypectomy and accelerated surveillance. When a polyp is removed, separate biopsies should be taken from the flat areas around the base of the polyp. If dysplasia is found in the area around the polyp then colectomy is recommended because of the high association with synchronous cancer. Dysplasia of any grade found in an endoscopically unresectable polyp or high-grade dysplasia found in flat mucosa are both strong indications for proctocolectomy.

High-grade dysplasia in a flat area is associated with a high risk of synchronous colorectal cancer elsewhere in the colon and a colectomy is recommended.

The management of low-grade dysplasia found in flat mucosa is controversial. Some investigators recommend colectomy whereas others recommend repeat colonoscopy within 6 months.

In a review of 10 surveillance studies low-grade dysplasia was associated with synchronous cancer in 19% of patients[73]. In patients who were followed after a diagnosis of low-grade dysplasia a significant number (16%– 29%) progressed to high-grade dysplasia, dysplasia-associated lesion or mass, or cancer.

A Comparison of MRI Colonography with Conventional Colonoscopy for the Assessment of Intestinal Inflammation in Patients with Inflammatory Bowel Disease[74] by Andreas shreyer MD, RSNA December 2004. In patients with UC and CD sever inflammation, pseudopolyps and complications like strictures are diagnosed by MRC but in most cases mild inflammation were not diagnosed by MRI.

COLONOSCOPY AND MRC IN IBD

MRC has no role in IBD either diagnosis or follow-up, but it has a role if the patent develops stricture/narrowing due to Crohn's disease.

ROLE OF COLONOSCOPY AND MRC IN COLONIC POLYPS

Colonic polyps are divided into two major groups:

Neoplastic (the adenomas and carcinomas) and Non-neoplastic.

Adenomas and carcinomas share a common characteristic—cellular dysplasia—but they may be subdivided according to the relative contribution of certain microscopic features.

The non-neoplastic polyps may be grouped into several distinct categories, including hyperplastic polyps, “mucosal polyps,” juvenile polyps, inflammatory polyps, and others. Submucosal lesions also may impart a polypoid appearance to the overlying mucosa and therefore are briefly mentioned even though they are not true polyps.

Adenomas are categorized into three size groups: <1 cm, 1 to 2 cm, and >2 cm.[75] Overall, most adenomas are smaller than 1 cm, but the size distribution of adenomas may vary greatly among studies, depending on study design, age of the study population, and location of the adenomas within the colon.

Adenoma size increases as a function of age,[76,77,78] even in low-prevalence countries,[79] and larger adenomas are more common in distal colonic segments.[75,80,81]

Diminutive polyps measure 5 mm or less in diameter and are commonly encountered during endoscopy. An earlier concept that these lesions were almost always non-neoplastic has been revised based on several flexible sigmoidoscopic and colonoscopic studies in which 30% to 50% of diminutive polyps were found to be adenomatous

Flat Adenomas.

Macroscopically, a flat adenoma is either completely flat or slightly raised and may contain a central depression. Typically less than 1 cm in diameter, these lesions can be missed easily at endoscopy. This potential risk has prompted investigators, particularly in Japan, to adapt better methods of detection that involve the use of dye-spraying (chromoendoscopy) to generate a contrast relief-map image of the mucosa, or magnification colonoscopy, for enhanced

visualization.[82] In studies without the use of such specialized endoscopic techniques, flat adenomas accounted for 8.5% to 12% of all adenomas and could be multiple.[83,84]

Serrated adenomas are polyps that share features of both adenomatous and hyperplastic polyps

Anatomic Distribution

The distribution of adenomatous polyps within the colon differs, depending on the method of investigation. In autopsy series, adenomas are distributed uniformly throughout the colorectum; this even distribution has been confirmed in colonoscopic investigations of asymptomatic subjects.[85,86]. Large adenomas in autopsy series have a distal predominance, in the region where most colon cancers arise, thereby supporting the adenoma-carcinoma hypothesis. Adenomas detected in surgical and colonoscopic studies of symptomatic people also display a left-sided predominance. In older individuals, those older than 60 years of age, adenoma distribution demonstrates a shift toward more proximal colonic locations.

Investigations

Colonoscopy is the gold standard for evaluation of colonic polyps, however for screening in asymptomatic individuals other non-invasive modality like MR Colonography and CT Colonography is preferable for initial assessment, once polyp has been confirmed by MRC it is better to subject the patient for colonoscopy and biopsy in order to plan further management.

Flat adenomas are missed even during routine colonoscopy evaluation, in those individuals other advanced modalities like Chromoendoscopy, and Narrow band imaging is preferable

OTHER ADVANCED IMAGING MODALITY

Chromoendoscopy:

Chromoendoscopy, or chromoscopy, refers to the topical application of stains or dyes at the time of endoscopy in an effort to enhance tissue characterization, differentiation, or diagnosis. The stains that are used for chromoendoscopy are classified as absorptive (or vital), contrast, or reactive. Absorptive stains, such as Lugol's solution and methylene blue, identify specific epithelial cell types by preferential absorption or diffusion across the cell membrane.

Contrast stains, such as indigo carmine, seep through mucosal crevices and highlight surface topography and mucosal irregularities. Reactive stains, such as congo red and phenol red, undergo chemical reactions with specific cellular constituents, resulting in a color change akin to a pH indicator.

Magnification endoscopy

Magnification endoscopy is often used to provide higher resolution images of the epithelium in concert with Chromoendoscopy. Most videoendoscopes provide optional magnified or "zoom" imaging. The most obvious application of this relatively simple technique is in the detection of duodenal villous atrophy. It also play a role in the evaluation of colonic lesions.

Narrow band imaging (NBI)

Narrow band imaging (NBI) involves the use of interference filters to illuminate a target in narrowed red, green and blue (R/G/B) bands of the spectrum. The imaging modality is built into commercial endoscopy processors and no catheters or probes are necessary. NBI provides

imaging of the surface of epithelium, particularly of the surface vascular pattern. Many early malignancies have surface pattern changes in vascularity, such as the corkscrew pattern seen in early gastric cancer[87]. When NBI is used in conjunction with magnification endoscopy, the diagnosis of metaplasia, dysplasia and cancer of the upper and lower GI tract can be secured with a high degree of accuracy[88]. In comparative trials, NBI has produced results similar to high-resolution Chromoendoscopy [89].

Endoscopic confocal microscopy

Endoscopic confocal microscopy provides the highest resolution images of the GI tract of any imaging modality[90]. The instrument is a dedicated endoscope with an independent processor and is not yet widely available. Confocal endomicroscopy uses blue laser light and is often used in conjunction with an intravenous and a topical fluorescent agent. The images obtained from this technique provide near real-time cellular details, including individual epithelial cells to a depth of 1–2 mm. The crypts of the colonic mucosa, the villi of the terminal ileum and duodenum, the gastric pits of the stomach, and the squamous epithelium of the distal esophagus can be clearly visualized. The technique has been demonstrated to improve the detection of dysplasia arising from the colonic mucosa in patients with inflammatory bowel disease[91].

Among the advanced imaging modalities Chromoendoscopy and NBI is available in some centers. It is very helpful especially in the evaluation of colon in following situations like.

To take targeted biopsy in patients with IBD on regular follow up to ruled out malignancy and to rule out malignant transformation of polyps and adenomas.

MATERIALS AND METHODS

Materials and Methods

This comparative study between Colonoscopy and MR Colonography was carried out in the Department of medical Gastroenterology and Radiology Department of Madras Medical College, Chennai. This is the major referral tertiary care center available to the entire Tamilnadu, Pondicherry and neighboring states like Andhra Pradesh and Karnataka.

The study was carried between the February 2008 to January 2010. (24 months)

Patients who are attending Medical Gastroenterology Department with clinical diagnosis highly suspicious of colorectal pathology were included in this study.

Sixty patients were taken up for study and out of sixty patients thirty patients underwent colonoscopy first then subjected to MR Colonography and another thirty patients were subjected for MR Colonography first then followed by Colonoscopy.

Inclusion Criteria

Patients with bleeding per rectum suggestive of colonic lesion rather than perianal problem like hemorrhoids or fissure

Significant weight loss & Change in bowel habits with Positive FOBT

Abnormal finding during rectal examination

Patients with family history of Colorectal Cancer/ Polyposis with symptoms of bowel disease.

CURRENT ACCEPTED INDICATIONS FOR MR COLONOGRAPHY

(1) Incomplete colonoscopy because an obstructing mass or stricture prevented examination of the proximal colon

(2) Incomplete colonoscopy because of colonic tortuosity, adhesions, severe diverticular disease, or patient intolerance of colonoscopy

(3) Inability to perform colonoscopy because of a strong requirement for anticoagulant therapy or risks of sedation

(4) Patients who have a strong indication for diagnostic colonoscopy but who adamantly refuse to undergo colonoscopy.

We have extrapolated the recommendations given for CT Colonography to MRC, since both the modality is technically same with the advantage of no radiation for MRC.

Exclusion criteria

Patients with metal implants like Hip prosthesis, cardiac pacemaker and intracranial aneurismal coil were excluded from MR Colonography

RELATIVE CONTRAINDICATION FOR MRC

(1) Severe allergy to administered contrast (MRC can be performed without contrast)

(2) Suspected colonic perforation or peritonitis

(3) Walled off colonic leak/pericolonic abscess

(4) Medically highly unstable patient (eg, unstable angina, uncontrolled sepsis)

(5) Acute lower gastrointestinal bleeding

(6) Pregnancy

(7) Inability to tolerate pneumocolon/water instillation

(8) Highly uncooperative patient

(9)Inability to undergo colonic preparation: congestive heart failure, severe electrolyte imbalances, severe dehydration

(10) Refusal to undergo colonic preparation

(11) Abnormal anorectal anatomy (eg, imperforate anus, tight anal stricture)

(12) Severe colonic disease (toxic colitis, toxic megacolon, severe colonic pseudo obstruction)

(13) Acute colonic infection (acute diverticulitis, severe infectious colitis)

(14) Complete mechanical colonic obstruction

(15) Very recent colonic surgery (<1 week)

Hip prostheses, which generally are not considered a contraindication to MR imaging, can result in considerable artifacts in the pelvis, thereby impeding acquisition of an image of the sigmoid colon and rectum that has adequate diagnostic quality

Study protocol

Patients attending medical gastroenterology outpatient department referred from various departments with history suggestive of large bowel pathology were included in the study. Their name clinical history, examination and investigation were entered in the proforma (Annexure). Patients with history and examination suggestive of organic problem alone were included in the study; those patients with history suggestive of Functional Bowel Disorders were excluded. Most of the patients were admitted in our ward and the rest of the patient was taken up for study from the respective wards.

Patient preparation

Most of the patients were prepared by giving Polyethylene Glycol colonic Lavage (Peglec net weight: 137.9 gms mixed with 2L of plain water gives Polyethylene glycol- 18meq/L, Sodium - 125meq/L, Potassium-10meq/L Chloride-35meq/L, Sulphate-80meq/L, Bicarbonate-20meq/L)

250ml of peglec solution given per orally every 15minutes. Usually first bowel movement occurs one hour after administration of peglec preparation, and then evacuation occurs several times, keep administering peglec until the rectal effluent is clear. Lavage is usually complete after the intake of 1.5-2L.

Patients with suspected bowel obstruction and rectal lesion were prepared by doing bowel wash with plain water until the wash become clear. Both colonoscopy and MRC procedure and the risks associated were explained in detail and informed consent was obtained from the patients (ANNEXURE). The patients were kept in only liquid diet from the previous night. Basic investigations (Blood and ECG) done for all the patients prior to procedure.

Equipment

Video Colonoscope – Pentax EC 3830/EC 3801L, 168 cm in length.

Light source and Image processor – EPM - 3300

1.5 Tesla MRI in Department of Radiology, Madras medical college.

Technique

After preparing the patient adequately thirty patients were taken up for colonoscopy first then MRC and the other thirty patients were taken up for MRC first then colonoscopy.

We do colonoscopy in our endoscopy suite regularly without anesthesia however for uncooperative patients and patients with intolerable pain related to procedure we give mild sedation like Inj. Promethazine 25 mgm or Inj.Midazolam 2.5-7.5 mgm. After putting the patient in left lateral position Rectal examination done then with adequate application of Lignocain gel over the distal end of the scope, colonoscope introduced into the rectum and by changing the patient position according to the site of scope tip, the procedure was done and one staff nurse assisted throughout the procedure.

MR COLONGRAPHY

Before starting the procedure, 20mg of Hyoscine was given IV to reduce peristalsis/spasm. After positioning the patient in Lithotomy position, Foleys catheter introduced into the rectum, 1.5 to 2.0 liter of plain water introduced into the rectum at the rate of 120ml/mt with IV administration of paramagnetic contrast gadolinium for enhancement of colonic lesions in case of dark lumen MRC. The lesion appears as *hypeintense* in dark lumen MRC. Diluted gadolinium is instilled into the rectum in case of bright lumen MRC.

MRC is performed from the level of the diaphragm to the level of the perineum. Images are obtained in both the supine and prone positions to

(1) Differentiate particulate stool from fixed lesions such as polyps or cancers

(2) Distend adequately colonic regions poorly distended in one position because the air is redistributed with a change in patient position

(3) Evaluate adequately colonic regions obscured by residual fluid because fluid is redistributed with a change in patient position. The optimal scanning technique should minimize scanning time, and maximize image quality.

We use to do MRC by using two techniques like Bright lumen MRC and dark lumen MRC.

Bright lumen MRC

With “bright lumen” MRC colorectal lesions are visualized as dark filling defects within the bright colonic lumen. This can be achieved by administering a rectal enema containing paramagnetic contrast. On 3D gradient echo data sets only the contrast-containing colonic lumen is bright whereas the surrounding tissues including ***colonic wall and polyps and other lesions remain low in signal intensity.*** A new approach for “bright lumen” MRC is based on the acquisition of True FISP (fast imaging with steady-state precession) sequences. Using a rectal water-enema, the contrast mechanism is comparable to that of the approach in conjunction with a paramagnetic contrast enema and the acquisition of T1w GRE sequences. Since the True FISP technique neither requires the administration of intravenous nor rectal paramagnetic contrast medium and it appears economically attractive. The detection of colorectal lesions with “bright lumen” MRC relies on the visualization of filling defects. Differential considerations for such a filling defect beyond polyps include air bubbles as well as residual fecal material. To permit differentiation datasets are collected in both the prone and supine patient position: air and fecal material move, while polyps remain stationary. While effective in most instances, the technique can introduce errors. Thus, polyps with a long stalk may move sufficiently to impress as a moving air bubble or more probably residual stool, while stool adherent to the colonic wall may not move at all and, thus, falsely impress as a polyp.

Dark lumen MRC

In addition to obviating the need for the time consuming 3D data acquisition "dark lumen" MRC[92] facilitates the identification of polyps and other lesions with in shorter period of time when compared to bright lumen technique. "Dark lumen" MRC focuses on the colonic wall. It is based on the contrast generated between a brightly enhancing colonic wall and a homogeneously dark colonic lumen. The technique differs from "bright lumen" MRC in the following manner:

(a) Instead of gadolinium containing enema only tap water is rectally applied rendering low signal on heavily T1weighted 3D GRE (Gradient echo) acquisitions.

(b) The colonic filling process is monitored with a fluoroscopic T2w sequence, rather than a T1w sequence.

To obtain a bright colonic wall paramagnetic contrast (Gadolinium based contrast agents like Gadopentetic acid (Magnevist) dose 0.1 mmol/kg) was given intravenously. 3D datasets are collected before the application and after a 75 second delay.

As residual air exhibits no signal in the colonic lumen, the examination needs to be performed only in the prone patient position. Furthermore, the "dark lumen" technique copes with the problem of residual stool in a simple manner: if the lesion enhances, it is a polyp or growth; if it does not enhance, it represents stool. While most mass lesions smaller than 5 mm in size were missed, almost all lesions exceeding 8mm were correctly identified. MRC identified additional lesions in regions of the colon not reached by colonoscopy in situation like obstructing type of rectal growth.Table – 3 showed the comparison of various MRC techniques

Aftercare

Patients underwent procedure without sedation and were asked to eat immediately after MRC/Colonoscopy. But if the procedure done under sedation the patient was allowed to take food only after 6 hours.

TABLE - 3

MRC - VARIOUS TECHNIQUES COMPARISSION

Parameters	Bright lumen	Black lumen	Fecal tagging
Bowel cleansing	Yes	Yes	No
Diet with barium	No	No	Yes
Enema	Gado in water	Water	Water
Filling sequence	2D GRE	2D Balanced GRE or T2	2D Balanced GRE
Enhancement with dynamic scanning	No	Yes	Yes
Combination bright black lumen	NA	With 3D balanced GRE sequence	NA
Cost factor	Costly	Relatively Cheap	Relatively Cheap

RESULTS

Results

Baseline characteristics

Sixty patients who fulfilled the study criteria were included in the present study.

The mean age was 47 years and the male female ratio of (M: F) 37: 23 (2: 1) (Fig-1)

Baseline characteristics of patients selected for study

Age in years (Median) - 47 years (Fig-2)

TABLE - 4

No	Age of the patients	No of patients (N-60)
1	50 years and above	27
2	40 – 49 years	13
3	30 – 39 years	13
4	<30 years	07

CLINICAL FEATURES AT PRESENTATION

Patients with clinical history and examination highly suggestive of organic lesions like bleeding PR, motion for occult blood positive and mass palpable per abdomen or growth rectum in PR examination only were included. Patients with history suggestive of functional bowel disorders were not included in this study.

Out of sixty patients nineteen patients presented with bleeding per rectum, thirteen patients presented with growth rectum on rectal examination and significant overlap of bleeding PR and growth rectum was seen. Six patients were diagnosed as IBD-UC, Seven patients diagnosed as TB abdomen, two patients diagnosed as rectal polyp, five patients with secondaries liver to rule out colonic lesions, FOBT positive in fifteen patients with suspected carcinoma colon and palpable RIF mass in one patient and diarrhea in one patient. (Table-5 and Figure-3)

TABLE - 5

Clinical features (History and Examination) with FOBT at presentation

No	Clinical features at presentation	No of pts.
01	Bleeding per rectum	19
02	FOBT Positive	15
03	Growth Rectum	13
04	TB Abdomen	07
05	IBD – UC	06
06	Secondaries Liver	02
07	? Growth Colon	03
08	Rectal polyp	02
09	RIF Mass	01
10	Chronic diarrhea	01
11	Anemia	01

Based on the above clinical/examination findings patients were subjected for Colonoscopy and MRC. Thirty patients were subjected first to colonoscopy followed by MRC and another thirty patients were subjected for MRC first then colonoscopy.

After adequate bowel preparation as discussed already colonoscopy done

COLONOSCOPY - Scope passed up to: (Fig - 4)

Ileum/Cecum	- 42 Patients
Ascending colon	- 05 Patients (5 Obstructing growth)
Hepatic flexure	- 01 Patients (1 Obstructing growth)
Transverse colon	- 01 Patients (1 Intussuscepting growth)
Splenic flexure	- 01 Patients (1 Poor pt. tolerance)
Descending colon	- 01 Patients (1 Obstructing growth)
Sigmoid	- 03 Patients (stricture 1 + obst.growth 1 + poor tolerance 1)
Rectum	- 06 Patients (6 Obstructing growth)

Out of sixty patient's colonoscopy passed up to cecum/ileum in forty-two patients, which accounts for 70%. In the remaining eighteen patients (30%) scope not passed up to cecum due to following reasons.

Scopes passed only up to mid-ascending colon in five patients due obstructing lesion were further scope negotiation not possible.

Scope passed up to hepatic flexure in one patient due to obstructing lesion

Scope passed up to mid transverse colon in one patient due to intussuscepting lesion

In one patient scope passed only up to splenic flexure due to poor tolerance

In one patient scope passed only up to descending colon due to obstructing lesion

Among ten patients with Growth Rectum, scope negotiation beyond the lesion was not possible in six patients due to obstructing growth.

Scope negotiation beyond sigmoid was not possible in three patients due to narrowing by stricture in one patient, obstructing growth rectosigmoid in one patient and patient intolerant to procedure in one.

Out of sixty, in eighteen patients complete examination of colon was not possible due to the reasons mentioned above, and among this obstructing lesion accounts for sixteen patients and patient intolerance account for two patients.

On the same day after colonoscopy MRC done in radiology department and in those patients subjected for MRC first, they underwent colonoscopy on next day. Both the findings are tabulated and compared to find out the merits and demerits of each modality and to find out the Sensitivity, Specificity, Positive predictive value and Negative predictive value of MRC in comparison with standard tool Colonoscopy.

TABLE - 6

INTERPRETATION OF COLONOSCOPY AND MR COLONOGRAPHY

NO	TYPE OF LESION	BY COLONOSCOPY	BY MRC
1	Growth rectum	10	10
2	Growth Rectosigmoid	03	03
3	Growth Descending colon	01	01
4	Growth transverse colon	02	02
5	Growth ascending colon	04	05
6	Proctitis	03	0
7	Proctosigmoiditis	04	2 normal and 2 thickened rectum
8	Left sided colitis	01	0
9	Rad. Proctosigmoiditis + stricture	01	Sigmo narrowing
10	Pancolitis	03	2 thicken RS & 1 normal
11	Ileocecal TB	04	3 Thicken cecum & 1 normal
12	Ileocecal Crohn's	02	0
13	Colonic polyps including FAP(2) & Solitary polyp	8 Polyp + 2 FAP	10 with additional findings
14	Solitary rectal ulcer	01	0
15	Sig diverticulosis with fistula	01	Only diverticulosis
16	Normal study	10	10

DIAGNOSTIC ACCURACY OF COLONOSCOPY AND MRC

From the above Table – 6 by comparing colonoscopy and MRC, diagnostic accuracy for the Growth arising from rectum, rectosigmoid, descending colon, transverse colon and ascending

colon is same. However one patient with obstructing growth rectum showed thickened ascending colon suggestive of? Synchronous lesion in ascending colon by MRC. One patient with post radiation Proctosigmoiditis and stricture in sigmoid colon by colonoscopy were reported as only narrowing of sigmoid? Stricture by MRC.

Four cases of suspected Ileocecal TB by colonoscopy (Fig-9) were reported as thickened wall of cecum in three patients and normal study in one patient by MRC.

One patient with sigmoid diverticulosis and low rectal fistula by colonoscopy were reported as diverticulosis by MRC and the fistula was not demonstrable.

Three cases of Proctitis, one left sided colitis and two Ileocecal Crohn's and one solitary rectal ulcer diagnosed by colonoscopy were reported as normal by MRC. (Table-7)

Among four cases of Proctosigmoiditis by colonoscopy two were reported as normal and the other two cases were reported as thickened wall of rectum? Significant by MRC.

Three cases of IBD – UC Pancolitis by colonoscopy were reported by MRC as normal study in one patient and thickened wall of rectosigmoid in two patient. (Table-7)

TABLE - 7

COLONOSCOPY AND MRC IN IBD

No	Colonoscopy findings	MRC findings
1	Proctitis in 3 patients	Normal study in 3 pts
2	Proctosigmoiditis in 4 patients	2 normal and 2 thickened rectum ?significant
3	Left sided colitis in 1 patient	Normal in that 1 patient
4	Pancolitis in 3 patients	2 thickened rectosigmoid ? significant & 1 normal
5	Ileocecal crohn's in 2 patients	Normal study of 2 pts

COLONOSCOPY AND BIOPSY

Biopsy done for all patients with lesion (growth/inflammation) during colonoscopy examination. Out of thirteen patients with growth rectum biopsy showed Adenocarcinoma in all of them.

Biopsy taken from five patients with growth ascending colon revealed Adenocarcinoma in three patients and non specific inflammatory infiltrate in two patients, but the repeat biopsy was positive for malignancy.

Two patients with growth transverse colon revealed Adenocarcinoma in both patients.

Biopsy taken from eight patients with colorectal polyp showed hyperplastic polyp in two patients adenomatous polyp in three patients and inflammatory cell infiltrate in three patients.

Two patients diagnosed as Familial Adenomatous Polyposis (FAP) (Fig-7). showed adenomatous polyp (one patient tubular adenoma and other one tubulovillous) in biopsy (Fig-10)

Twelve patients with inflammatory disorder of the colon like Proctitis, Proctosigmoiditis, Left sided colitis and pancolitis showed varying inflammatory cell infiltrate (No evidence of dysplasia in all patients)

Biopsy done in four patients with suspected Ileocecal TB revealed Non-specific inflammation in two patients and caseating granulomas in two patients.

Biopsy taken from suspected Ileocecal Crohn's showed non-specific inflammation in one patient and non-caseating granulomas in one patient.

COLONOSCOPY AND POLYPECTOMY

Out of eight patients with colorectal polyp, polypectomy done for five patients and another three patients did not report for polypectomy.

ADDITIONAL FINDINGS BY MRC WHEN COMPARED TO COLONOSCOPY

(a) In one patient with growth mid-descending colon with luminal narrowing, scope not passable beyond the obstructing lesion, the MRC showed a polypoid lesion in splenic flexure in addition to growth. (Table - 8)

(b)In another patient colonoscopy passed only up to splenic flexure due to poor patient tolerance, showed a polyp in sigmoid colon; however MRC showed another polypoid lesion in ascending colon.

(c)Three patients with obstructing growth rectum where scope not passable beyond the lesion (Fig-8) subjected for MRC showed thickened wall of ascending colon in one patient and thickened wall of descending colon in one patient suggestive of? Synchronous lesions and polypoid lesion in descending colon in another patient.

TABLE - 8

ADDITIONAL FINDINGS WITH MRC

No	Type of lesion	Colonoscopy	MRC
1	Growth descending colon	Growth mid descending colon	Growth mid descending colon with polypoid lesion in splenic flexure
2	Sigmoid polyp	Sigmoid polyp	Sigmoid polyp with another polyp in ascending colon
3	Growth rectum	Growth rectum	Growth rectum with thickened wall of ascending colon? Synchronous lesion
4	Growth rectum	Growth rectum	Growth rectum with thickened wall of descending coon? Synchronous lesion
5	Growth rectum	Growth rectum	Growth rectum with polypoid lesion in descending colon

EXTRACOLONIC FINDINGS ON MR COLONOGRAPHY

Among ten patients with Growth rectum diagnosed by MRC, three patients showed pelvic nodal involvement and one patient showed liver metastasis (Fig-6). Among two patients with growth transverse colon (growth transverse colon + growth proximal transverse colon and hepatic flexure) and five patients with growth ascending colon one patient in each showed liver metastasis. In addition to liver metastasis one patient with ascending colon growth also showed cholelithiasis. One patient with Proctitis showed left renal calculi with cholelithiasis but normal

study of colonic lumen by MRC. One patient with radiation Proctosigmoiditis with stricture showed sigmoid narrowing with left sided hydrouretronephrosis by MRC. (Table-9)

TABLE - 9

EXTRACOLONIC FINDINGS ON MR COLONOGRAPHY

No	Colonoscopy	MRC – Colon findings	Extracolonic findings
1	Growth rectum (n-10)	Growth rectum	Pelvic nodes with liver mets
2	Growth rectum (n-10)	Growth rectum	Pelvic nodes
3	Growth rectosigmoid (n-3)	Growth rectum	Pelvic nodes
4	Growth Transverse colon(n-2)	Growth Transverse colon	Liver mets
5	Growth ascending colon (n-5)	Growth ascending colon	Liver mets with Gallstones
6	Proctitis (n-1)	Normal study	Left renal calculi with Gallstones
7	Radiation proctosigmoiditis with stricture at sigmoid (n-1)	Sigmoid narrowing	Left sided Hydrouretronephrosis

MRC WITH MRI FOR STAGING GROWTH RECTUM

As a routine we did MRI Abdomen and Pelvis in all patients subjected for MRC, which was very useful for staging purpose. As per latest recommendation High spatial resolution 3 Tesla MRI is very accurate in determining the Mesorectal fascia involvement, which is very helpful for surgeons in planning circumferential resection. In addition to detection of Mesorectal fascia

involvement T2 W thin section MRI abdomen also detects peritoneal infiltration and extramural rectal involvement.

3 Tesla MRI is highly sensitive and ideal for staging growth rectum, but in our institution we have only 1.5 Tesla MRI, using this we did routine staging of rectal cancer. Out of 13 patients with growth rectum 5 patients underwent CT Abdomen already, as suggested by their respective ward medical officer, but while comparing the diagnostic and staging accuracy of CT Abdomen and 1.5 Tesla MRI Abdomen, both modalities diagnostic accuracy was same.

STATISTICS

MRC * Colonoscopy Crosstabulation

			Colonoscopy		
			Positive	Negative	Total
MRC	Positive	Count	24	5	29
		% of Total	40.0%	8.3%	48.3%
	Negative	Count	21	10	31
		% of Total	35.0%	16.7%	51.7%
Total		Count	45	15	60
		% of Total	75.0%	25.0%	100.0%

Based on the above findings when comparing MRC with gold standard Colonoscopy:

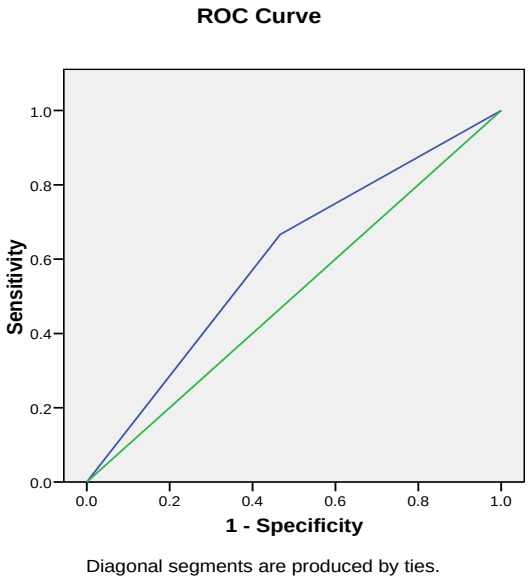
TABLE - 10

No	Parameters	Percentage %
1	Sensitivity	53%
2	Specificity	67%
3	Positive predictive value	83%

4	Negative predictive value	32%
5	Pearson chi-square (p)	>0.05(NS)

Both sensitivity and specificity is not significantly high for MRC when comparing standard tool colonoscopy.

Negative predictive value is also very low and only the positive predictive value is significant to some extent (Table - 10)



ROC – 0.6

ROC is 0.6 in my study, if ROC is more than 0.8-0.9 then the sensitivity and specificity is better and we can recommend that modality.

In future 3 Tesla MRC may play a role in screening for polyposis and colorectal cancer in selected populations but cannot replace the gold standard COLONOSCOPY.

DISCUSSIONS

DISCUSSION

Colonoscopy is the gold standard for evaluation of colonic lesions and also to take biopsy and for various therapeutic purposes, however we see lot of obstructing type of rectosigmoid growth were passage of scope beyond the lesion was not possible, hence we planned to do alternative investigation, that is MR Colonography, since MRC is the latest modality it's not been much discussed even in standard gastroenterology and radiology textbooks, but lot of studies available for MRC especially about its role in polyposis colon, IBD and CRC screening programme.

MR Colonography is similar to CT Colonography, but it differ from CT colonography in following aspects like

(1). No radiation (2). Need not give nephrotoxic contrast agents (3). Better than CT in staging Growth rectum

After discussing with radiology department professor and asst. Professor i started doing MRC with following protocol

Inclusion and Exclusion criteria as discussed already

Patient with clinical history and examination strongly suggestive of organic lesion in colon alone were included in this study. Patients with history suggestive of functional bowel disorder were excluded from the study.

Out of sixty patients, colonoscopy done first for thirty patients and for the other thirty patients MRC done first followed by other modality.

The diagnostic accuracy of both colonoscopy and MRC is same in 34 patients, however biopsy and polypectomy was possible only with colonoscopy.

The diagnostic accuracy of colonoscopy scores over MRC in twenty one patients in determining various lesions like IBD – Proctitis, Proctosigmoiditis, Left sided colitis and pancolitis, Solitary rectal ulcer, Ileocecal TB, Crohn's disease and Sigmoid diverticulosis with fistula. In all the conditions mentioned above in addition to diagnosis, biopsy was taken from suspected lesion for HPE confirmation.

The diagnostic accuracy of MRC scores over colonoscopy in five patients. In one patient growth mid descending colon scope passage was not possible beyond the lesion due to obstructing growth, but MRC showed a polypoid lesion in splenic flexure in addition to growth mid descending colon.

Among six patients with obstructing growth rectum, were scope passage was not possible beyond the lesion, MRC showed a polypoid lesion in descending colon in one patient, thickened wall of ascending colon (?Synchronous lesion) in one patient and thickened wall of descending colon in another patient (?Synchronous lesion)

The staging accuracy of Growth Rectum with MRC and MRI abdomen is better than CT Abdomen, we did staging with 1.5 Tesla MRI available in our institution, the staging accuracy is comparable or even superior to CT Abdomen and pelvis, especially to find out the nodal and Mesorectal fat involvement. (3 Tesla MRI is superior and very accurate for staging growth rectum)

The diagnostic accuracy of detecting polyp with MRC is more than 90 % if the polyp size is more than 5mm. Colonic wall thickening brought out well with MRC if the lesion size is more than 5mm.

Several studies showed poor sensitivity of MRC in detecting polyp of size less than 5 mm, however in condition like Familial Adenomatous polyposis, in which colon is studded with polyps, it is easy to diagnose polyps even though the size is less than 5mm.

In my study, one patient with FAP the diagnostic accuracy of both modalities is same. In other patient, FAP with growth rectum also the diagnostic accuracy of both modalities are same.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

This study includes total of sixty patients with a mean age of 47 years and the male female ratio of 2:1

Among the clinical symptoms and abnormal finding on examination the most common symptom being bleeding per rectum seen in 31%, Growth rectum in 21% and suspected IBD-UC in 10% and the remaining 38% constitute all other presentation.

FOBT Positive in 25% of patients with suspected colorectal malignancy, clinically suspected TB abdomen in 11% of patients.

Colonoscopic assessment of the entire colon up to cecum/ileum was possible in forty two patients (70%) and in the remaining eighteen patients (30%) scope not passed up to cecum due to obstructing lesion in sixteen patients (27%) and the patients intolerance to procedure in two patients (3%) in my study.

Biopsy was taken from all patients with colorectal growth and inflammatory lesions, while doing colonoscopy. Biopsy taken from growth arising in Rectum, Sigmoid, and Transverse colon the yield rate was 100% and the Histopathology report (HPE) was Adenocarcinoma. Similarly Ascending colon growth biopsy revealed 100% positive for malignancy.

Biopsy from Suspected Ileocecal TB revealed caseating granulomas in 50% and non-specific inflammatory infiltrate in another 50% of patients.

Biopsy taken in patient with familial adenomatous polyposis showed adenomatous polyp (100%).

Biopsy is very important in planning the management which is possible only with colonoscopy

Out of eight patients with colorectal polyp, polypectomy done for five patients and the remaining three patients did not report for polypectomy.

The obstructing type of lesions (27%) and poor patient tolerance (3%) accounts for 30% incomplete study, where in the alternative modality MRC was helpful to evaluate rest of the colon.

Both colonoscopy and MRC detects lesion with same accuracy in thirty four patients (57%), colonoscopy detects lesions missed by MRC in twenty one patients (35%) and MRC detects the lesion missed by Colonoscopy in five patients (8%), because of non-passage of scope. (Fig - 5)

Overall accuracy of Colonoscopy is 92% (both modality same accuracy in thirty four patients + colonoscopy scores over MRC in twenty one patients) in assessing colonic lesions. (Fig - 5)

Overall accuracy of MRC is 65% (both modality same accuracy in thirty four patients + MRC detects lesion missed by colonoscopy in five patients) in accessing colonic lesion

Extracolonic findings were detected by MRC in seven patients in addition to colonic lesions viz. Pelvic nodes, Liver metastasis, Gall stones. Left Renal calculi and Left sided Hydrouretonephrosis

Statistically while comparing the MRC with standard tool Colonoscopy the Sensitivity - 53% , Specificity – 67%, Positive predictive value – 83% and Negative predictive value – 32% and the p-value is also not significant (>0.05), suggesting MRC is only an alternate modality if colonoscopy is not possible.

In future 3 Tesla MRI with advanced software may play an important role in evaluation of colonic lesions especially for screening Polyposis and Colorectal cancer but still colonoscopy will be needed for tissue diagnosis.

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ANNEXURE

STUDY OF COLONOSCOPY AND MRC

No.		

PROFORMA

Name: **Age/Sex**: **IP No**:

Address: **Phone No:**

Presenting complaints:

Abdominal Pain : Yes/ No **Duration**: days/ months

Onset : Rapid/ Insidious

Progressive/ Non-progressive

Loose stool **:** Yes/ No **Duration**: days/ months

Mucous **:** Yes/ No **Duration**: days/ months

Bleeding PR **:** Yes/ No **Duration**: days/ months

Constipation **:** Yes/ No **Duration**: days/ months

Alternate constipation and loose stool

: Yes/ No **Duration**: days/ months

Wt. loses : Yes/ No **Duration**: days/ months

Loss of appetite : Yes/ No **Duration**: days/ months

Other symptoms :

Past History

H/O Similar episodes in the past

Co morbid conditions like DM/SHT/IHD

Previous H/O TB

Personal History:

Alcohol intake

Smoking

Examination *:*

Pallor

Lymphadenopathy

Generalised wasting

Eye manifestation

Skin and Joint manifestation

Abdomen

Mass Yes/No

Bowel sounds

Free fluids

Rectal examination

Proctoscopy

Investigations:

TC DC: N/L/E:

Platelet count: ESR:

FOBT

Blood urea

Sr. Creatinine

HIV I and II

USG Abdomen

Colonoscopy

MR Colonography

Histopathology

CONSENT FORM

Title of project: **"COLONOSCOPY AND MR COLONOGRAPHY – A COMPARATIVE STUDY"**

Name of the researcher: Dr. R. Karthikeyan MD

I confirm that I have read and understand the information provided to me for the above study

I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.s

I understand that my participation is voluntary and that I am free to withdraw at anytime, without giving any reason, without my medical care or legal rights being affected

I agree to take part in the above research study.

_____	_____	_____
Name of the patient	**Date**	**Signature**

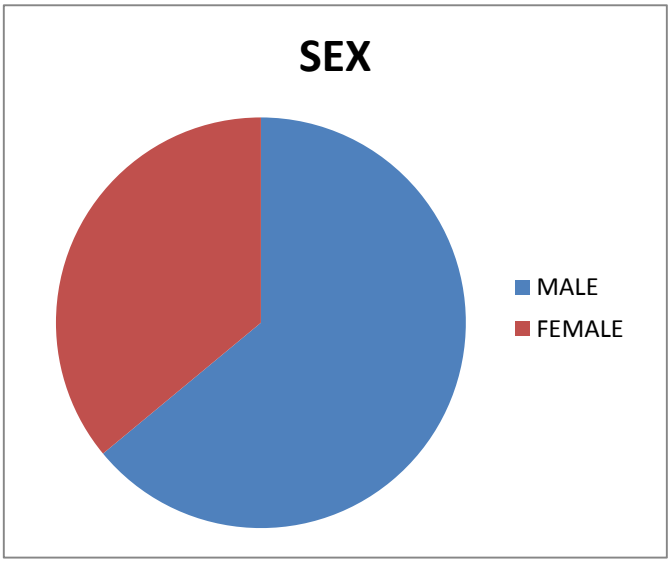
_____	_____	_____
Name of the person taking consent	**Date**	**Signature**

(if different from researcher)

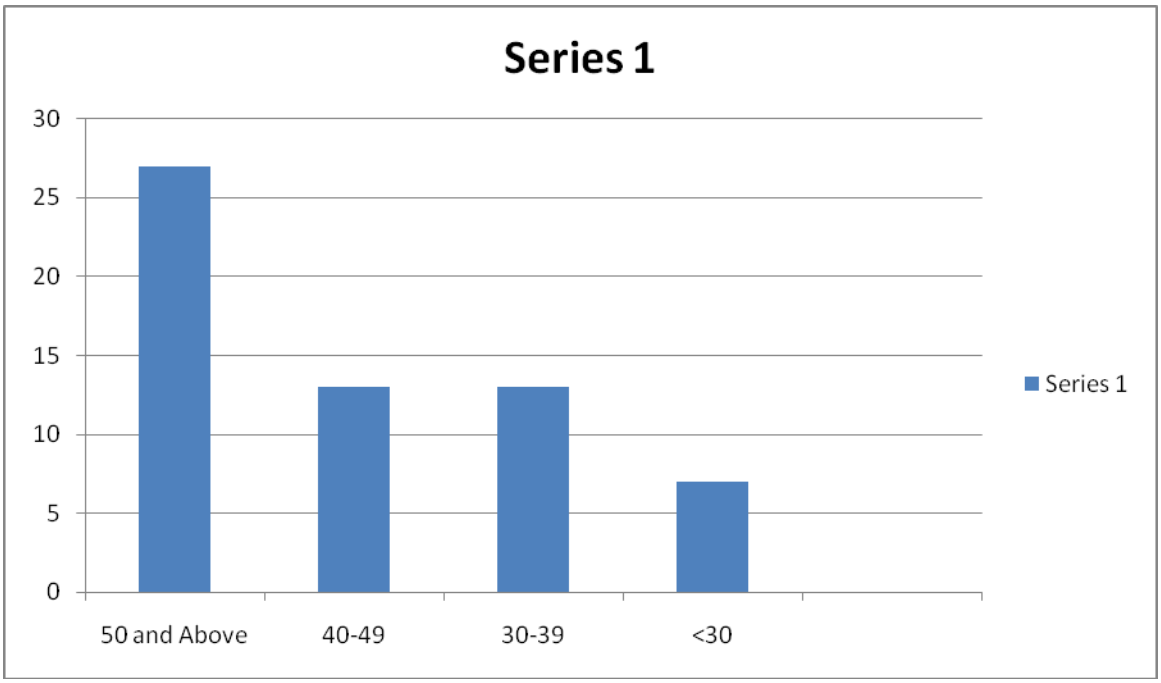
_____	_____	_____
Researcher	**Date**	**Signature**

CHARTS AND PICTURE

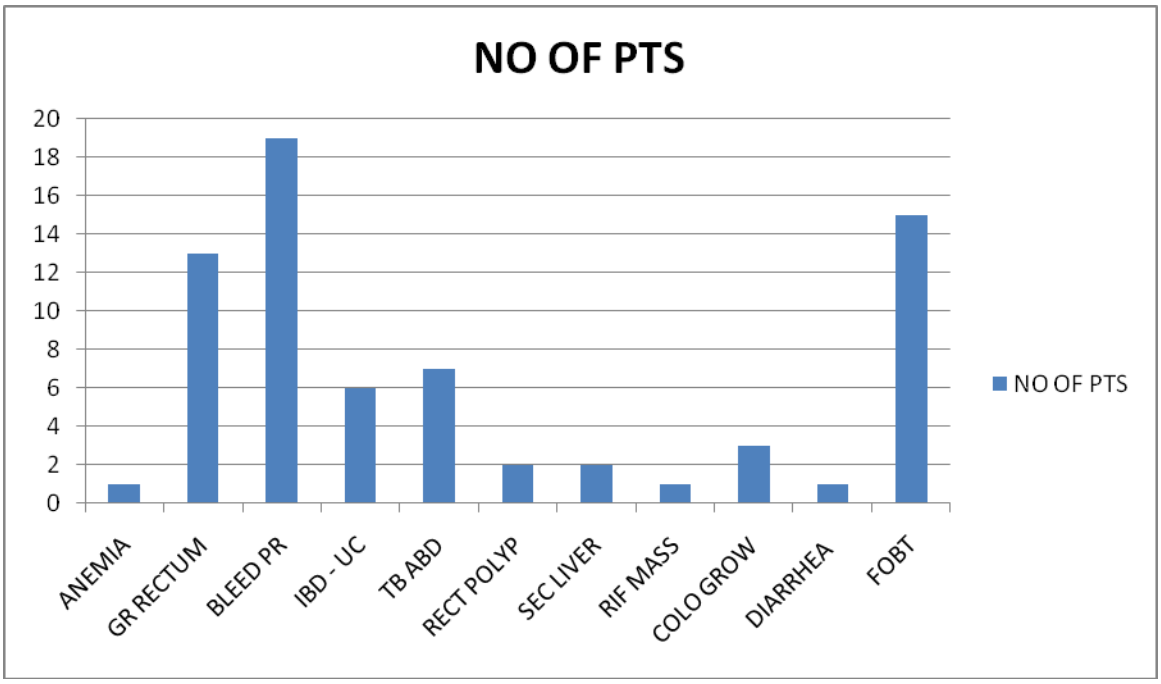
SEX INCIDENCE (Fig - 1)



AGE INCIDENCE (Fig - 2)



CLINICAL DIAGNOSIS AT PRESENTATION (Fig - 3)



DURING COLONOSCOPY SCOPE PASSED UP TO (Fig - 4)

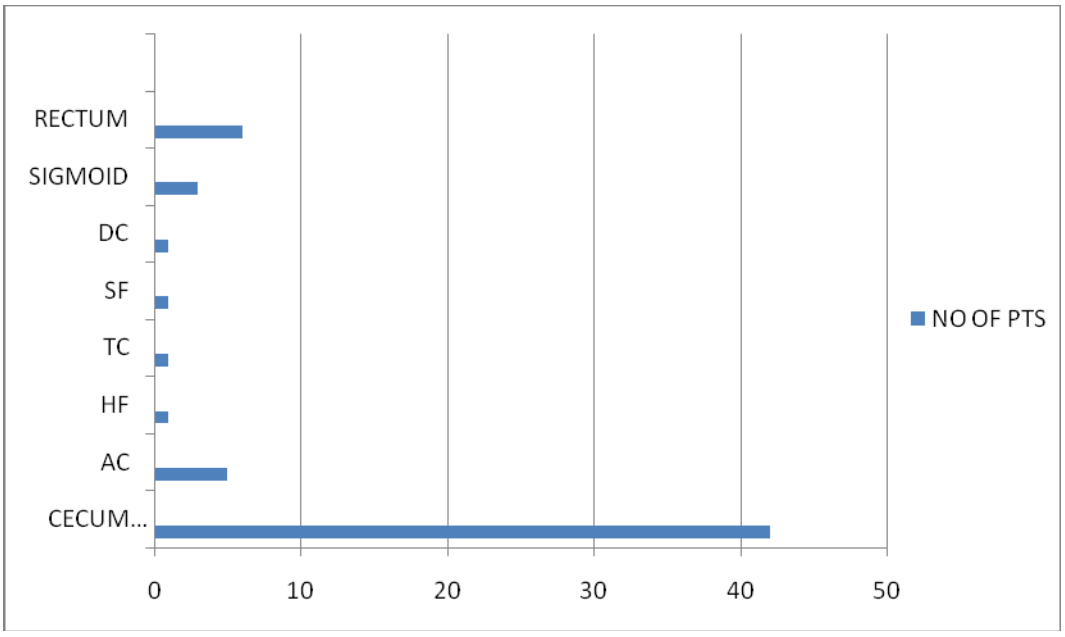
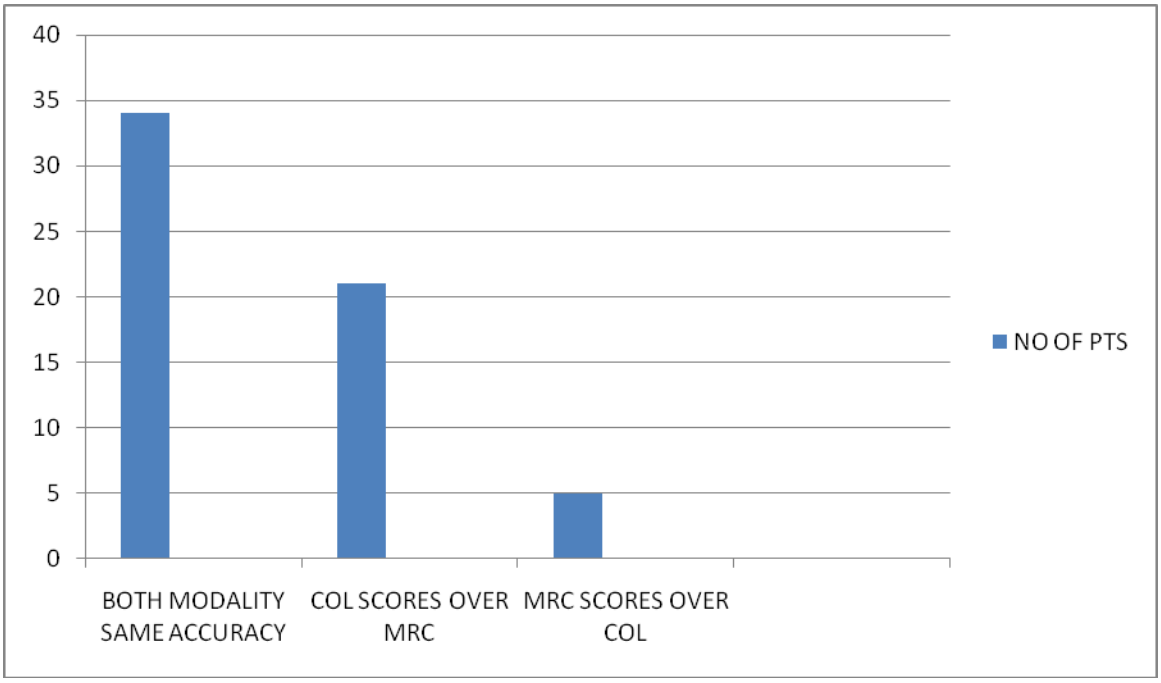
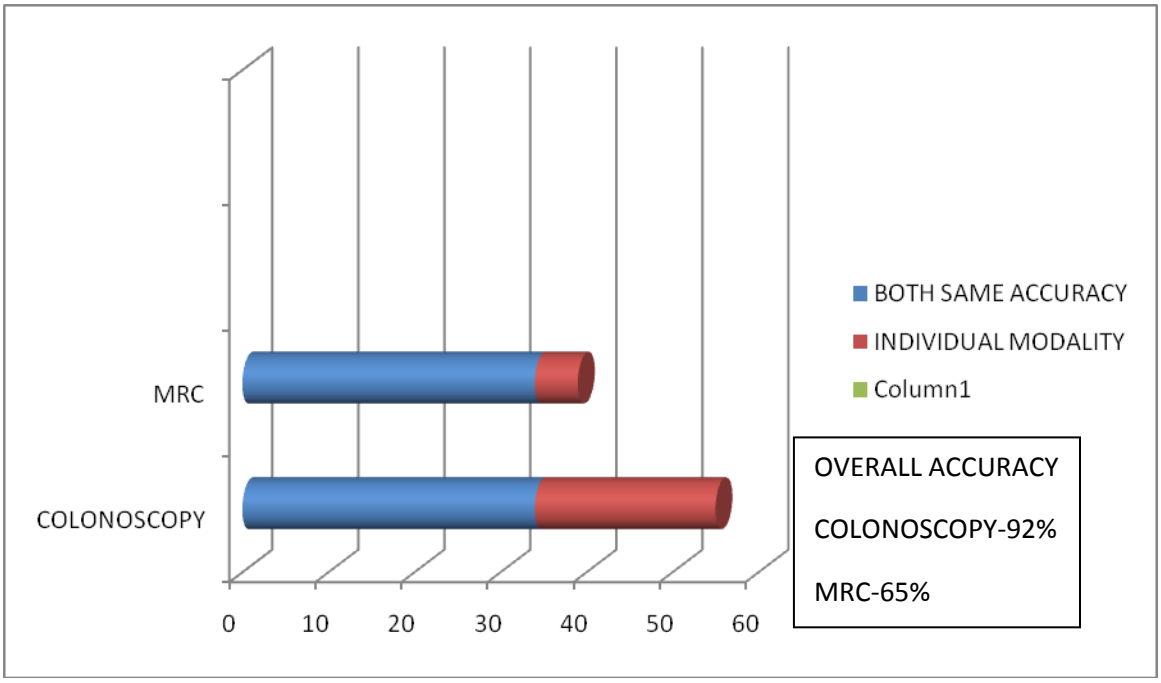


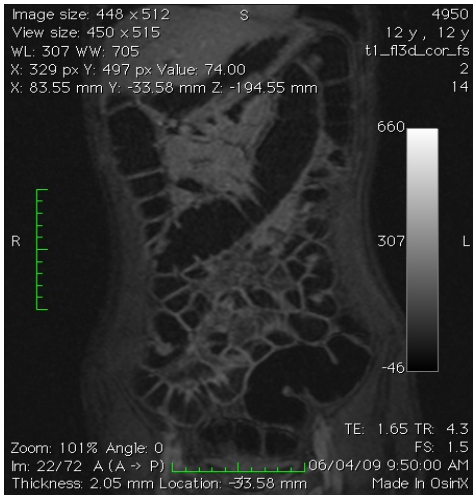
Fig - 5

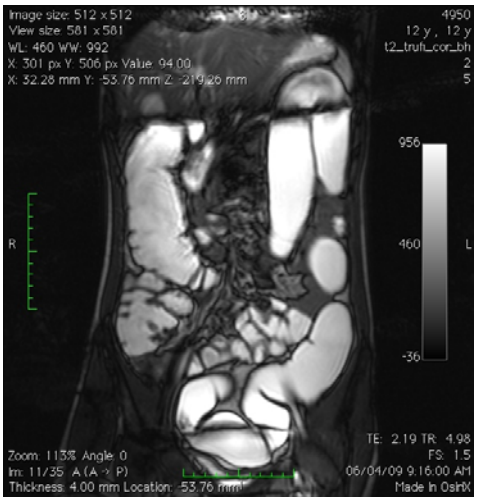
DIAGNOSTIC ACCURACY OF BOTH MODALITIES (COLONOSCOPY AND MRC)



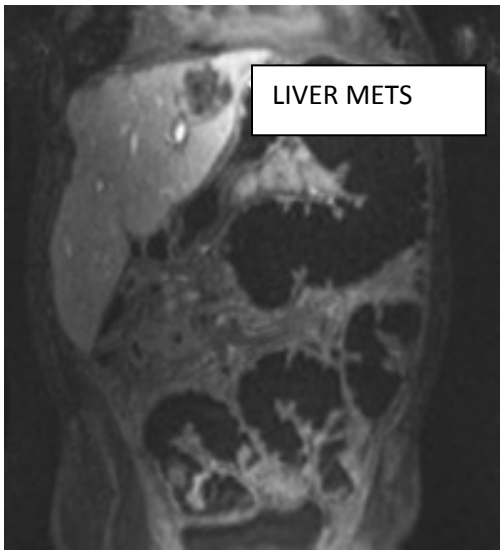


NORMAL APPEARING DARK LUMAN AND BRIGHT LUMEN MRC

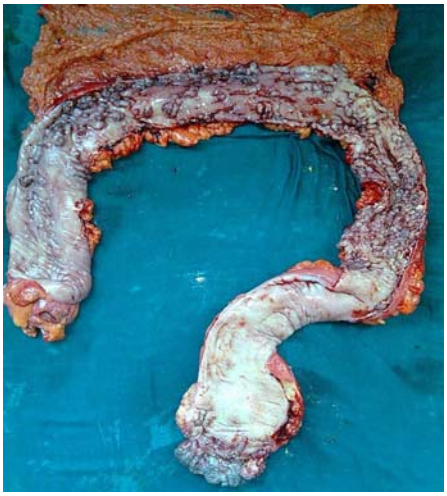




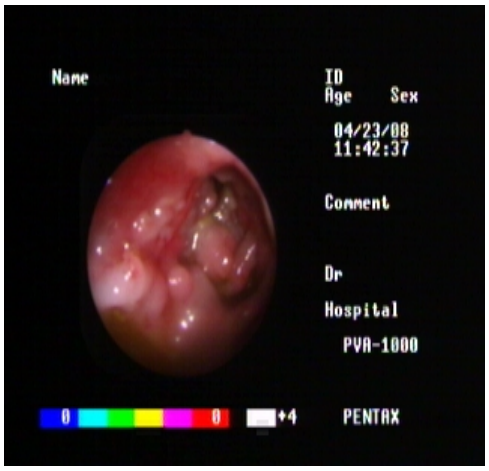
DARK LUMEN MRC WITH LIVER METASTASIS (Fig-6)

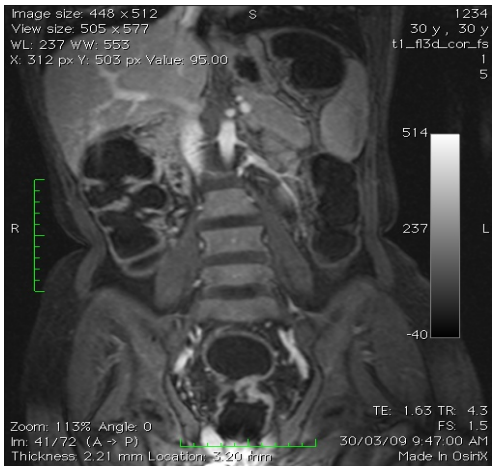


FAP (Fig-7)

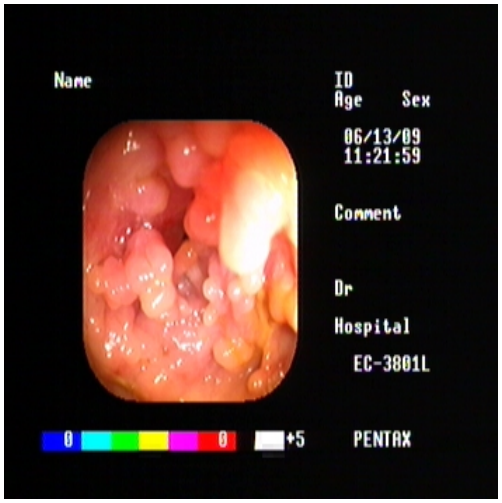


OBSTRUCTING RECTAL GROWTH (Fig-8)



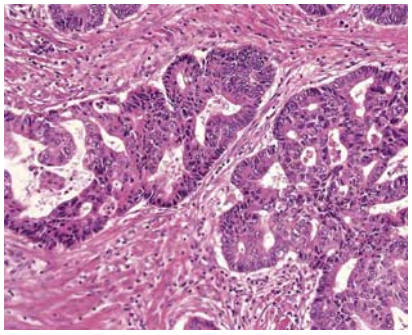


ILEOCECAL TB (Fig-9)

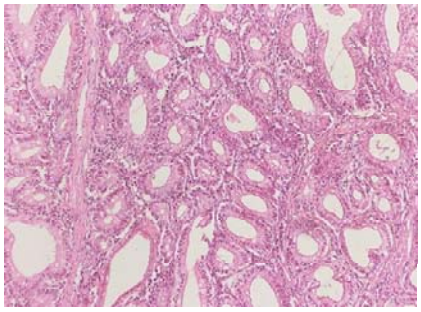


HISTOPATHOLOGY (Fig-10)

Adenocarcinoma



Tubular Adenoma



Crohns granuloma